Alberta
Innovates
Energy and
Environment Solutions

Powerful ideas
Global impact

STRATEGIC BUSINESS PLAN

2012-2015

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Executive Summary

> ***"Excellence in research, innovation and commercialization drives Alberta's future success."***
> Goal outlined in Advanced Goal outlined in Advanced Education and Technology 2011 – 2014 Business Plan

Alberta Innovates – Energy and Environment Solutions (AI-EES) is part of Alberta Innovates, a collaborative system built on a strong legacy and proven success. As the lead agency for energy and environmental research in Alberta, AI-EES brings together decision makers from government and industry as well as research and technology organizations, to develop solutions for the biggest challenges facing Alberta's energy and environment sector.

Within this Strategic Business Plan, you will read about our purpose, priorities and goals. We will also share details on new research, technology developments and projects that could change the way people think about responsible energy development, the oil sands, clean energy and more effective management of greenhouse gases and water. You will also gain an understanding of how we are working to implement the goals of the province's strategies in energy, climate change and water. AI-EES will take bold, decisive action to implement energy and environmental innovations and position Alberta as a global leader. AI-EES' actions will help Alberta achieve a competitive advantage, greater sustainability and manage external risks.

Context

The province relies on the energy industry for much of its prosperity. Nearly 140,000 Albertans are employed by the energy sector and it is anticipated approximately $200 billion[1] will be invested in the industry in the next two decades. In 2010-11 Alberta revenue from oil sands and conventional oil accounted for the major part of Alberta's non-renewable resource revenue and this trend is expected to continue.

There is no question Alberta is part of the global economy. We are affected by global markets, the price of oil and natural gas, the desire for a clean environment, and the perceptions of a sceptical public. For this reason, it is imperative that our natural sources are developed cleanly and with minimal impact on the environment, which includes responding to the call to lower greenhouse gas emissions (GHG), manage oil sands tailings ponds and the overall use and disposal of water.

Key Challenges

The province is affected by the current global economic uncertainty and unprecedented volatility combined with a fast-growing environmental consciousness. Key issues affecting Alberta include:

- The weakness of European and U.S. economies
- Low natural gas prices
- U.S. demand for petroleum-based transportation fuels is continuing to fall
- Volumetric restriction on Alberta bitumen to market representing an estimated value loss of over $10 billion per annum for Alberta[2]
- Low carbon fuel standards in the U.S. and Europe have cast the spotlight on oil sands crudes as being of higher carbon content and may further erode bitumen's market position
- Canada has been slow in developing renewable energy.

1 http://www.oilsands.alberta.ca/economicinvestment.html
2 Figure calculated by Jacobs Consultancy.

These trends all show the need for strong leadership and vision from the Government. Alberta cannot take it for granted that our resources will be accepted as fuels in the long term. As new fuels and energy sources are developed, the world may turn to alternative suppliers. Alberta needs to act now to ensure its long term prosperity.

Expected Outcomes

Our Vision

Alberta leads the world in developing innovative energy and environmental technologies building on our natural advantages to achieve a prosperous, environmentally and socially sustainable diversified economy.

Our Mission

To increase Alberta's capacity to develop and successfully adapt innovative technologies that maximizes the value of Alberta's natural and renewable resources while protecting the environment.

AI-EES' ultimate goal is to position Alberta as an international leader in the low carbon clean energy economy with efficient and well managed water systems. To achieve this, we have completed a thorough examination of the environment in which we work, the key challenges we face, analyzed numerous studies and roadmaps, and consulted with our stakeholders. This has led to the establishment of four strategic program areas and goals.

Energy Technologies

- Recovery and Processing Goal: Support the development and demonstration of key technologies that will be incorporated into two or more pilots/demonstrations of sustainable bitumen and heavy oil recovery and processing and upgrading technologies.
- Clean Carbon Goal: Support the development and demonstration of key technologies that will be incorporated in one or more clean coal/carbon demonstration plants converting low-value fuels into electricity, hydrogen, heat and chemicals with minimal adverse impact on the environment and the capability of capturing CO_2.
- Evaluation and Development Goal: Monitor the industry outlook and support the development and review of key technologies for future recovery opportunities.

Renewable and Emerging Resources

- Renewable Energy Goal: Demonstrate geothermal and bioenergy technologies which utilize municipal solid waste, forestry and agricultural residues, and produce power, hydrogen and liquid fuels.
- Alternate Fuels Goal: Support the development of underground coal gasification and low carbon and higher valued fuels.

Environmental Management

- Oil Sands Tailings Goal: Enable the industry to achieve long-term objectives set out by ERCB and Alberta Environment and Water for effective tailings management policy and regulation development.
- Enhanced Ecology Goal: Develop the technologies and performance matrix to achieve environmental sustainability in Alberta. This includes water, land, and air management, and sustained biodiversity; using life cycle analysis (LCA) and sustainability indices as performance measures and benchmarking tools.
- Carbon Capture and Storage Goal: Develop cost effective carbon capture, safe and reliable geological storage, and CO_2 enhanced oil and gas recovery technologies to meet Alberta's GHG reduction goals; develop monitoring, measurement, and verification technologies to support policy and regulatory developments.

Water Resources

- Water Security, Risk and Vulnerability Goal: Support an improved understanding of the qualitative and quantitative aspects of Alberta's dynamic water supplies, storage systems and the interaction between surface water and groundwater systems.
- Watershed Stewardship and Ecosystem Management Goal: Promote improved and sustainable water management outcomes through collaborative and integrated decision-making processes supported by openly accessible scientific data collection and analysis focused on basin-specific goals and objectives.
- Conservation, Efficiency and Productivity of Water Use Goal: Enhance Alberta's water future by taking an integrated and 'systems' approach to water challenges, including valuation of water focused on the needs of Alberta.

To reach these goals, AI-EES has established long term targets aligned with provincial strategies. These targets are used for planning the type of initiatives that AI-EES will promote and support. These targets are summarized in the following Table.

Technologies and Management Targets by 2030		
De-Carbonization	**Clean Energy**	**Clean Water**
• 50% reduction on GHG emissions on a per equivalent barrel basis	• 20% of energy is derived from renewable resources	• 30% increase in water efficiency
• 20% reduction in energy consumed in the production of bitumen	• Coal-fired power plants in Alberta at natural gas equivalent	• 75 million m^3 reduction from Directive 074 target
Commercial and Next-Generation		
• 3 million barrels per day of heavy oil and bitumen production • 20% increase in conventional oil recovery • 15% of gas will come from non-conventional sources		

AI-EES believes that these targets can be achieved by following a systematic process and by making strategic investments in research, technology and innovation. Using our process, AI-EES has been able to achieve challenging advancements:

- Initiated the End-To-End Tailings Management Consortium involving nine industry members tasked with finding solutions to tailings ponds reclamation
- The development of UOP/Statoil's production technology that takes low-grade heavy residues from bitumen processing and turns it into high value oil and transportation fuels
- Implementation of the City of Edmonton's waste to biofuels program
- Valuation of wetland health in support of Alberta's wetland policy.

These are just a few examples of ideas that would not have succeeded without AI-EES' proactive leadership.

Descriptions of selected examples of outcomes achieved since the completion of our last Business Plan are provided in the Outcomes and Performance Measures Section (page 27).

Building on Success

AI-EES is the successor to the Alberta Energy Research Institute and the Alberta Oil Sands Technology and Research Authority (AOSTRA). With the incorporation of the Alberta Water Research Institute as the Water Resources area, we are well-positioned to tackle today's environment and technology challenges. AI-EES acts as a catalyst for developing innovative, integrated ways to convert our natural resources into market-ready, environmentally responsible energy, and provides a technology context to government policy makers.

> ***"We propose as a flagship initiative the creation of a Global Centre for Energy – a crucible for accelerating innovation to transform environmental and operational performance."***
>
> Report of the Premier's Council for Economic Strategy, "Shaping the Future", May 2011, Page 24

Global Energy Leadership

Premier Redford envisions Alberta at the centre of the international energy industry, signalling that Alberta will be positioned as a global leader in sustainable hydrocarbon production and renewable energy production.

It is clear that sustainable hydrocarbon production places greater emphasis on environmental performance of the highest standards in regulatory and monitoring systems and technical innovation and collaboration. The rebranding of the environmental portfolio as the Ministry of Environment and Water also provides an increased emphasis on the protection of the Province's water resources. For renewable energy, prominence will be given to areas where Alberta has a natural advantage and where there is significant potential in the diversification of our energy economy.

This 2012 Business Plan signals the start of an exploratory period for forming the Global Centre for Energy. And in May, key stakeholders will come together for a visioning workshop to examine this direction. AI-EES' innovation management team is already implementing the Province's strategies in clean energy, improved environmental performance, efficient production, product quality and the management of carbon and water under its four strategic areas. Enhancing the alignment across the innovation system and especially making use of all the talent available in the Alberta Innovates system and Campus Alberta will be critical to a natural progression towards the Global Centre for Energy.

In reference to the AOSTRA model: "It (the Global Centre for Energy) will not build a large institution staffed with researchers. Instead, it will have a small staff who scout the world for ideas and technology. Centre staff will manage contracts for research, development and operational testing of solutions by appropriate external resources. The Centre has access to research labs, and a mandate to build the infrastructure necessary to test and demonstrate solutions at industrial scale."

Report of the Premier's Council for Economic Strategy, "Shaping the Future", May 2011,
Page 36 http://alberta.ca/home/1429.cfm

An Improved AOSTRA Model

As referenced in the Report of the Premier's Council for Economic Strategy, the Alberta Oil Sands Technology and Research Authority (AOSTRA), which was created in the mid-1970s to turn the oil sands into a commercial industry, represents a successful technology model to be emulated if Alberta is to achieve its goal of becoming a global energy leader. There were three critical features in the structure of AOSTRA that would need to be repeated to position Alberta for the future in energy and environment:

- **Vision**: Government sets the vision and is clear about Alberta's strategic self-interest and the end-game
- **Leadership**: Government shoulders the leadership role and works with industry from a position of strength to expand the type of collaborative effort currently taking place through the Canadian Oil Sands Innovation Alliance (COSIA), the Canadian Clean Power Coalition (CCPC), Natural Resources Canada (NRCan) and the emerging national collaborations in renewable and emerging resources and water
- **Resources**: Government declares itself ready to commit significant additional resources as part of the launch of the Global Centre for Energy.

The main aim of the new organization would be to catalyze a revolution in Alberta's energy sector with the key driver being the urgent need for innovation to maintain and enhance our economy, our quality of life and the revenue to support essential social services. The Global Centre for Energy would be the international leader in the clean technology revolution, driving to the lowest possible carbon content in its fuels and electricity and maintaining clean water systems. This would ensure that Alberta's products can meet the industrial and environmental challenges and compete effectively in global markets.

At a high level this would require a commitment to visionary and determined leadership fashioned on the following principles:

- Build on Alberta's natural advantages to achieve a prosperous, environmentally sustainable and socially responsible diversified energy economy;
- Maximize value of our hydrocarbon and renewable energy and exploit their synergies
- Position Alberta as a clean technology leader to assist in diversifying the energy and environment economy
- Create a balanced portfolio focused on the key technical, environmental, economic challenges to accelerate the realization of the solutions and the opportunities
- Collaborate nationally and internationally to advance key technology platforms
- Work with the public, Alberta government and key stakeholders to achieve the desired outcomes.

Alberta has a history of great success in achieving breakthroughs in energy research and technology. In all cases these have resulted from strong government-industry partnerships, based on a clear business case and with well-developed and articulated implementation strategies.

Government-industry partnerships, open innovation and leadership in research and technology development are the cornerstones of the Global Centre for Energy's philosophy to deliver the best available energy and environmental solutions, meet the talent challenge and manage (not necessarily control) intellectual property. All projects and initiatives would be stage-gated with a clearly defined exit strategy for near-commercial or commercial-scale technology initiatives. Global Centre for Energy staff or consultants would be embedded directly in projects involving piloting, demonstration and support for university research.

Technology Scouting

Technology 'scouting' is a major plank in the Global Centre for Energy's bridge to the future. A network of technology scouts would be set up within the Alberta Innovates system and over time in key parts of the world, to provide credible information on new technologies that can be adapted for Alberta's needs. In close collaboration with Alberta Ministries, the scouting approach would also provide for direct international connection to assist in exporting Alberta's energy and environmental goods and services. Scouts could serve as global emissaries showcasing Alberta's environmental record in energy development based on scientific information that is open and transparent.

Inclusive Innovation Dialogue

It is critical that the Global Centre for Energy contributes to the quality and timeliness of decision making when it comes to dealing with complex environmental needs and social issues in the context of provincial interests. Working with key Alberta Ministries, a comprehensive plan and structured approach would be developed to promote the participation of the public, First Nations and non-government organizations and to encourage mature, constructive dialogue based on the science of solutions. The objective is to support and enhance the legitimacy and the practicability of policy and regulatory requirements through better integration of public values based on the best available technical knowledge.

Recommended Global Centre for Energy Operating Principles

- The Global Centre for Energy would be fully accountable to the Government of Alberta with its five-year rolling Business Plan approved by the Government annually. The Centre would be open to receive assignments from the government on strategic issues of importance to Alberta.
- The Global Centre for Energy would not build a large institution staffed with researchers. Instead, it would have a staff with domain expertise augmented by scouts who scour the world for ideas and technology.
- The Centre staff would manage contracts for research, development and operational testing of solutions by appropriate external resources.
- The Centre would work with research labs, and have a mandate to build the infrastructure and Alberta talent necessary to test and demonstrate solutions at an industrial scale.
- The Centre would fully integrate the work of the Climate Change and Emissions Management Corporation and other energy and environment funding instruments of government into the portfolio to ensure a one-window approach in managing energy, environment and water outcomes.
- The Centre would develop a network of expert resources from industry, academia, NGOs and professional services across Canada and the world, and serve as a neutral "safe space for dialogue and collaboration".[3]
- The Centre would work on environment solutions using technology with a high degree of community engagement and involvement.

3 Report of the Premier's Council for Economic Strategy, "Shaping the Future", May 2011, Page 36

- The Centre would focus on the science of making the right choices and risk assessment based on the cycle time associated with, for example, climate change, energy security and catalyzing institutional change.
- The Centre would promote technology transfer to industry by managing data in real time to better direct the assets and manage the technology transfer process.

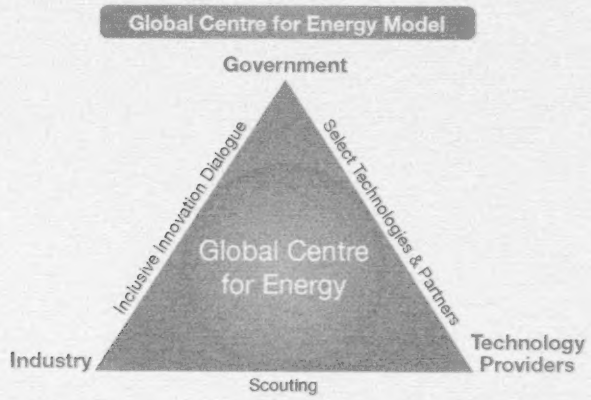


Figure 1: Schematic of the Global Centre for Energy to enhance collaboration and partnership focused on priority outcomes in energy, environment and water.

Board of Directors

(As of April 1, 2012)

Eric Newell, *Chair*

Kathleen Sendall, *Vice-Chair*

Directors:

Doug Beever

Paul Clark

David Lewin

David Lynch

Aaron Falkenberg

Charlie Fischer

Peter Fritz

Paul Galachiuk

Robert Mansell

Eddy Isaacs, CEO of Energy and Environment Solutions, ex-officio member of Board

Our Team

Eddy Isaacs, Chief Executive Officer

Energy Technologies

Les Little, Executive Director, Energy Technologies

Shunlan Liu, Director, Processing and Products

Kate Wilson, Director, Technology Development

Bruce Duong, Project Specialist, Technology Development

Environmental Management

John Zhou, Executive Director, Environment Management

Rick Nelson, Senior Director, Oil Sands Tailings

Vicki Mitchell, Project Specialist, Environmental Management

Renewable and Emerging Resources

Surindar Singh, Executive Director, Renewable and Emerging Resources

Mark Summers, Director, Nanotechnology

Water Resources

David Hill, Executive Director, Water Resources

Dianne White, Program Officer, Water Resources

Operations Staff

Alice Barr, Director, Strategic Planning and Operations

Michelle Gurney, Communications Director

Libuse Kuzel, HR Consultant

Lisa Spinks, Technology Transfer Manager

Janet Lilly, Records Clerk

Lindsey Mosher, Information Management Officer

Carol Weis, Information Management Officer

Marta Bor, Contracts Administration

Amanda Chamzuk, Payroll Specialist

Emily Fedick, Administrative Support

Donna Kostuik, Financial Administration and Executive Assistant

Lolita Ledesma, Administrative Support

Scouts

David Butler, Senior Advisor, Clean Coal

Duke du Plessis, Senior Advisor, Energy Technologies

Xiaomei Li, Senior Advisor, Bioenergy

Dzung Nguyen, Senior Advisor, Renewable Energy

Alexander Zehnder, Scientific Director, Water Resources

Mandate

Vision[4]

Alberta leads the world in developing innovative energy and environmental technologies building on our natural advantages to achieve a prosperous, environmentally and socially sustainable diversified economy.

Mission

To increase Alberta's capacity to develop and successfully adapt innovative technologies that maximizes the value of Alberta's natural and renewable resources while protecting the environment.

AI-EES achieves its mission by:

- Promoting collaborative research and development along the entire innovation chain, in partnership with industry and other funding organizations
- Working closely with all of the Alberta Innovates corporations and the Alberta departments of Energy, Environment and Water, Treasury Board and Enterprise, and Sustainable Resource Development to strengthen the province's energy and environmental sectors
- Taking a strategic view that links knowledge and needs
- Acquires, advances and integrates the knowledge vital to maintaining Alberta's global leadership in energy and the environment.

The AI-EES mandate has been provided by the Minister of Advanced Education and Technology and described in the Mandate and Roles Document found on the AI-EES website and includes the following key statements:

- Alberta Innovates – Energy and Environment Solutions is an integral part of Alberta Innovates, a strategically aligned and integrated provincial research and innovation system. Under the banner of Alberta Innovates, we work with key innovation support agencies, with publicly funded post-secondary institutions, industry and government to further develop research and innovation in the province and make Alberta more competitive in the global economy
- AI-EES serves as the research, innovation and technology implementation arm for Government of Alberta ministries in energy and environment, applying world-class research and innovation management strategies to preserve and enhance Alberta's economic, environmental and social well-being.

AI-EES will create value through:

- Increased effectiveness and integration of planning, funding and delivery of research and innovation programs
- Alignment of programs and investments toward priority areas and outcomes
- Improved facilitation of knowledge, intellectual property, technology and skill transfer within the innovation system, and between academia, industry and government
- Improved accountability and outcomes through integrated performance monitoring and continuous improvement processes.

4 Vision Statement approved by AI-EES, Feb 11, 2010

- AI-EES will integrate a disciplined research and innovation process to inform government policy and regulations for sustainable development
- AI-EES promotes the implementation of energy and environmental technologies in Alberta and will conduct its activities with the following specific goals:
  - Supporting enhanced performance and productivity in Alberta's energy and environmental sectors through research, innovation and technology development
  - Providing proactive leadership to support implementation of the research and components on key Government of Alberta Strategies[5]
  - Co-coordinating research plans and supporting activities among Government of Alberta ministries with a research and innovation focus on energy and the environment.

5 A complete list of strategies that AI-EES supports is on page 23.

Competitive Context

Alberta is part of the global economy. We are affected by global markets, the price of oil and natural gas, the desire for a clean environment, and the perceptions of a skeptical public.

Alberta has the largest reserves of hydrocarbons in the world that are not under the control of the state. The world will continue to rely on hydrocarbons as a major fuel source for decades to come, so it is imperative that these sources are developed with a minimal impact on the environment. Alberta is a price taker in terms of oil and natural gas. We do not set world prices for oil, and our economic success often mirrors the highs and lows of the oil and gas markets.

Alberta relies on the energy industry for much of its prosperity. Nearly 140,000 Albertans are employed by the energy industry and approximately $200 billion will be invested in the industry in the next two decades[6]. In 2010-11 Alberta revenue from oil sands and conventional oil accounted for the major part of Alberta's non-renewable resource revenue and this trend is anticipated to continue given the decline in natural gas revenue due to market conditions.

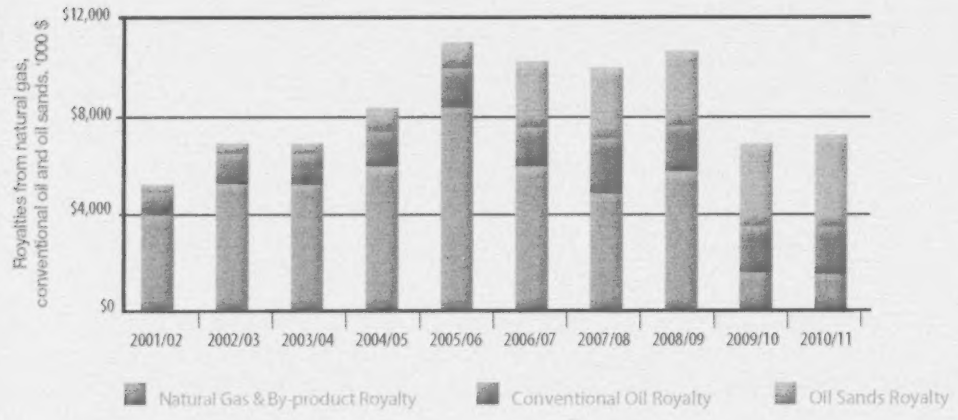


Figure 2: Shows the large decline in natural gas royalties and the significant growth in revenue especially from oil sands but also conventional oil. For simplicity revenue from land sales, coal royalties and other fees are not shown. Alberta Energy data available at http://www.energy.alberta.ca/About_Us/2564.asp

The challenge is that more than two-thirds of the oil, even in the best managed conventional pools in Alberta, is left in place using today's technology. With the advent of advanced hydrofracturing techniques applied to tight oil reservoirs, however, Alberta's conventional oil has witnessed a major increase in production over the past year. The potential is for production of conventional oil to reach levels not seen since the 1980's. The hydrofracking process mixes large quantities of water with chemical and sand (to prop up fractures) at very high pressure to break up rock formations. As such there is potential for environmental issues and especially contamination of water systems. Without better technology to reduce environmental risks, the growth in tight oil production will be constrained. At the same time, there are indications that the growth in oil sands production will be hampered by decline in demand and volumetric restriction on Alberta bitumen to market, significantly depressing the realized value. Currently available technology does not create competitive product quality or commercial recovery of Alberta's unconventional hydrocarbon resources in relation to competing sources. New sources from U.S. Bakken-type tight-oil, natural gas liquids (from shale gas) and biofuels are eroding Alberta's ability to compete and reducing the overall value it receives from its production base.

6 http://www.oilsands.alberta.ca/economicinvestment.html

Alberta has large biomass, wind, solar and geothermal resources, as well as world-class deep coal deposits. The province produces and consumes vast amounts of hydrogen. We have an extensive energy infrastructure and the right expertise needed to research, develop, operate and maintain the latest installations to take advantage of all of our natural resources.

Alberta has a great and highly diverse landscape. We have water, mountains, deserts, and plains. We expect our environment to be clean, and we expect our government to protect our environment. And that includes responding to greenhouse gas emissions, oil sands tailings ponds, and the overall use and disposal of water.

The role and importance of water to the future of Alberta cannot be underestimated. Its connection to human health and well-being, to ecosystem health and sustainability, to the extraction of Alberta's energy resources, to agriculture and forestry and the unique beauty of the Alberta landscape demands concerted effort and attention to assure the Province's future wealth and environmental prosperity.

The Challenge

Alberta's energy resources[7] are world class and an engine of wealth, yet they are challenging to produce and it can be difficult to realize their full market value. The Province is also affected by the current period of extreme global economic uncertainty and volatility combined with a fast-growing environmental consciousness. Some key issues that significantly impact Alberta include:

- The weakness of European and U.S. economies with significant fall in business spending and access to traditional financial markets
- Low natural gas prices continuing into the foreseeable future and decreasing demand for Alberta's natural gas have resulted in significant decline of natural gas as a source of revenue for Alberta
- U.S. demand for petroleum-based transportation fuels is continuing to fall and there is an oversupply of oil sands derived products in PADD 2 (U.S. Mid-West), the delivery point of most oil sands crudes
- Volumetric restriction on Alberta bitumen to market, significantly depressing realized value and all Canadian crudes are suffering from price devaluation due to high differentials between heavy and conventional crudes. This represents an estimated value loss of over $10 billion per annum for Alberta[8]
- Low carbon fuel standards in the U.S. and Europe have shined the spotlight on oil sands crudes as being of higher carbon content and may further erode bitumen's market position;
- Canada has been very slow in developing renewable energy and is not taking advantage of Cleantech[9] opportunities
- Most critical, Alberta is perceived as a lagging jurisdiction in dealing with the environmental matters – air, water, land and biodiversity.

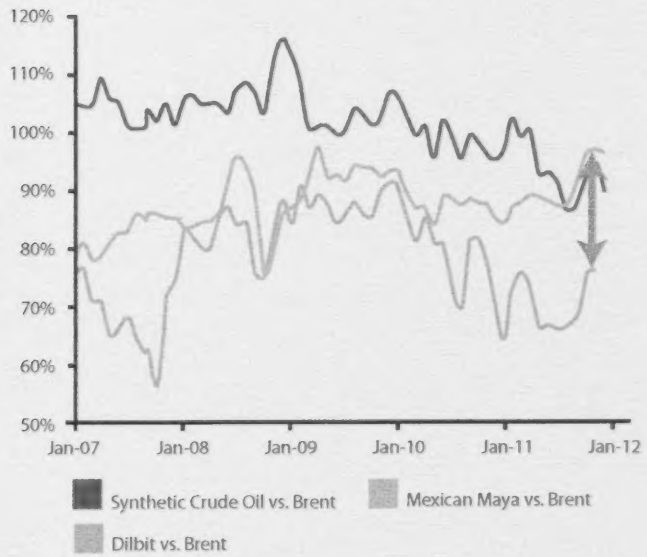


Figure 3: Showing the differential in percent between oil sands crudes (synthetic crude oil and dilbit) and Brent crude. The Brent and Maya crude differential is also shown. The arrow shows the Maya vs. dilbit differentials and provides a rough estimate of the dilbit value loss in 2011. Figure is courtesy of Jacobs Consultancy and based on public domain and estimates from ERCB data.

7 Includes oil sands, natural gas, coal, conventional oil, shale oil, and renewable resources.

8 Figure provided by Jacobs Consultancy.

9 Cleantech is a term used to describe products or services that improve operational performance, productivity or efficiency while reducing costs, inputs, energy consumption, waste or environmental pollution. Its origin is the increased consumer, regulatory and industry interest in clean forms of energy generation. The term 'cleantech' is often associated with venture capital funds.

Trends and Implications for Alberta

The table below provides a high-level environmental scan for Alberta in energy and environment and identifies and recommends response to the threats that Alberta is facing.

Trends	Implications for Alberta
The global economy is increasingly characterized by greater energy demand, huge uncertainties, changing market dynamics and demand for environmentally friendly goods and services.	A business-as-usual approach carries huge risks for Alberta. A transformative strategy is needed to diversify both markets and products for exports and achieve a paradigm shift in environmental performance.
The United States' emphasis on energy security, combined with reducing oil imports, impact of Energy Security Acts, assigning responsibility for GHG emissions to individual sectors.	Alberta's energy sector must invest in clean energy extraction technologies, carbon capture and storage, and renewable energy technologies, in order to remain The United States' preferred energy supplier.
Introduction of Low Carbon Fuel Standards in California, 14 other U.S. states, Ontario and British Columbia.	This is a major threat to our energy sector, but it can be alleviated by acting on the strategies listed in the Climate Change Strategy: greening energy production, implementing carbon capture and storage, and improving energy efficiency and conservation.
Market Trends – growing demand for clean fuels (increased production of cleaner fossil fuels, biofuels and electrification of the transportation system) in North America.	Results in decreased demands for gasoline and diesel and potential lower oil and gas prices and sales. This could have serious implications for the province's economy, particularly lower employment in the energy industry and reduced royalties payable to the Provincial treasury.
Abundant natural gas supplies – some of which are due to major shale gas discoveries – near U.S. and Eastern Canadian markets and improved production technologies will keep gas prices depressed.	Alberta's natural gas supply cost is disadvantaged in being distant from markets. While tight gas accounts for about a third of Alberta's natural gas production, without technological breakthroughs it is likely that growth in costly to produce shale gas and coalbed methane will be modest at best.
Strong demand for renewable and alternative fuels (e.g. Alberta standard is for 2% biodiesel and 5% ethanol in transportation fuels).	Alberta has the infrastructure and expertise to develop other fuel sources and could lead the transition to a global, low-carbon economy. Standards need to be considered and developed.
Uncertainty about water supply into the future due to water scarcity, melting glaciers, low water tables and overuse may mean less water for all users.	There will be increased pressure on all industries to show improved water management performance. Government will need to develop science-based policy and regulation to reverse unsustainable trends and to provide oversight.
The high cost and long lead times necessary to commercialize new clean energy technologies requires sustained, long-term government support.	Alberta needs to stay the course in terms of long-term, sustained funding for research and innovation in energy and the environment.
Increasing oil production in Alberta due to increased pressure from U.S. and global markets for greater energy supplies and security.	Alberta needs technology breakthroughs in production performance for both conventional heavy oils and oil sands that are considerate of environmental goals to reduce carbon footprint, improve water quality and reclaim industrial land.
The rate of energy development is perceived to have outpaced environmental and social acceptance of the energy industry.	Alberta has undertaken campaigns to address these issues, but more work is required to get the science based facts and figures to Albertans and our largest markets.

These trends all show the need for strong leadership and a strong vision from the Government. Alberta cannot take it for granted that our resources will be accepted as fuels in the long term. As new fuels and energy sources are developed, the world will turn to alternative suppliers. Alberta needs to act now to ensure its long term prosperity.

As outlined in the Report of the Premier's Council for Economic Strategy, a Global Centre for Energy that scouts the world looking for the best new technologies to be adopted, adapted and advanced in a way that supports Alberta's natural advantages in hydrocarbon resources will propel the province to a strong future. New and transformative technologies are needed to ensure long-term, sustainable development of Alberta's resources for the benefit of all Albertans.

AI-EES is focused on advancing technologies and practices that reduce carbon emissions across the energy industry, and the amount of water used across the province. These factors are the starting point for AI-EES' strategic programs and operational methods.

AI-EES Strategic Goals and Priority Program Areas

AI-EES takes a strategic approach in collaboration with industry and with others in the Alberta Innovates and Campus Alberta systems to ensure that our investments in research and technology align with the priorities of our sole shareholder, the Government of Alberta (GOA). With a budget of more than $84.9 million over the next three years, the goals and outcomes outlined in this business plan are targeted to new knowledge, and the application of that knowledge to advance commercial solutions within the energy and environment sector.

We have scanned the government of Alberta priorities and strategies, undertaken road mapping exercises, consulted with industry and academia, and therefore, re-confirmed our four strategic areas for this 2012 Business Plan. These strategic areas are: Energy Technologies, Environmental Management, Renewable and Emerging Resources and Water Resources.

Each Strategic Area is led by an Executive Director and a team of professionals that have created the following long term vision statements.

STRATEGIC AREA	VISION
Energy Technologies	Alberta is a global leader in adapting and integrating technology and knowledge for the effective and environmentally sustainable production, processing and utilization of hydrocarbon resources with minimal impacts on land, water, and air.
Renewable and Emerging Resources	Energy production is augmented from our renewable and emerging energy resources to help Alberta become a low carbon economy.
Environmental Management	Alberta is a global leader in environmental management and sustainable resource development.
Water Resources	Alberta is globally recognized as a leader in managing its water resources for people, the environment and the economy.

These vision statements are supported by specific programs in each strategic area. In turn, each program also has its own goals and targets.

STRATEGIC AREA	PRIORITY PROGRAM	GOALS AND 2030 TARGETS
Energy Technologies	Recovery and Processing	Support the development and demonstration of key technologies that will be incorporated into two or more pilots/demonstrations of sustainable bitumen and heavy oil recovery and processing and upgrading technologies. By 2030, technologies will have been developed that support increased recoverable heavy oil and bitumen production by 20%, reduced production emissions by 50%, and upgrading and processing efficiencies by 20%.
	Clean Carbon	Support the development and demonstration of key technologies that will be incorporated in one or more clean coal/carbon demonstration plants converting low-value fuels into electricity, hydrogen, heat and chemicals with minimal adverse impact on the environment and the capability of capturing CO_2. By 2030, key technologies will have been developed, demonstrated, and incorporated into clean carbon/coal commercial demonstration facilities converting low grade feedstocks into clean products with minimum adverse impact on the environment including net GHG emissions.
	Evaluation and Development	Monitor the industry outlook and support the development and review of key technologies for future recovery opportunities.
Renewable and Emerging Resources	Renewable Energy	Demonstrate geothermal and bioenergy technologies which utilize municipal solid waste, forestry and agricultural residues, and produce power, hydrogen and liquid fuels. By 2030, Alberta will have a strong and diversified renewable energy manufacturing sector which provides high-paying technical jobs in rural communities.
	Alternate Fuels	Support the development of underground coal gasification and low carbon and higher valued fuels. By 2030, Alberta will be a global leader in underground coal gasification and other alternate energy technologies.

Environmental Management	Oil Sands Tailings	Enable the industry to achieve long-term objectives set out by ERCB and Alberta Environment and Water for effective tailings management policy and regulation development. By 2030, more than 25% of legacy mature fine tailings will have been eliminated and oil sands tailings water is treated for re-use or progressively returned to the environment. Fresh water use intensity for in situ oil sands production will be reduced by 50% compared to 2010.
	Enhanced Ecology	Develop the technologies and performance matrix to achieve environmental sustainability in Alberta. This includes water, land, and air management, and sustained biodiversity; using life cycle analysis (LCA) and sustainability indices as performance measures and benchmarking tools. By 2030, Alberta's resource industry will be recognized globally as a clean, low carbon, low water industry.
	Carbon Capture & Storage	Develop cost effective carbon capture, safe and reliable geological storage, and CO_2 enhanced oil and gas recovery technologies to meet Alberta's GHG reduction goals; develop monitoring, measurement, and verification technologies to support policy and regulatory developments. By 2030, Alberta will be on track to meet Alberta's 2050 GHG emission reduction goals (200 Mt/yr reduction by 2050) and the well-to-tank carbon intensity of bitumen-derived fuel is 10% lower than the average of U.S. domestic and imported petroleum fuels.
Water Resources	Water Security, Risk & Vulnerability	Support an improved understanding of the qualitative and quantitative aspects of Alberta's dynamic water supplies, storage systems and the interaction between surface water and groundwater systems. By 2030, Alberta will have the tools to ensure sound water management practices, safe, secure drinking water, and augmented water re-use strategies for commercial and industrial applications.
	Watershed Stewardship & Ecosystem Management	Promote improved and sustainable water management outcomes through collaborative and integrated decision-making processes supported by openly accessible scientific data collection and analysis focused on basin-specific goals and objectives. By 2030, Alberta will be recognized globally for its water management practice by putting in-place an evidenced based system to manage ecosystems in all of its watersheds and by providing open access to data on all water resources.
	Conservation, Efficiency & Productivity of Water Use	Enhance Alberta's water future by taking an integrated and 'systems' approach to water challenges, including valuation of water focused on the needs of Alberta. By 2030, Albertans will have developed a water conservation ethic; the value of water is well-established and used to support sustainable watershed management.

Summaries of the strategies and programs – with a focus on shorter term 2020 goals – are in Appendices A to D.

The four strategic areas, with their programs, goals and targets are the starting components that are proposed for the new Global Centre for Energy. AI-EES would develop additional strength in engaging the public and first nations in managing environmental issues and in developing scouts to facilitate

technology access and serve as technical ambassadors in their communities. Meeting additional staff needs can be achieved with the increased use of shared staff from Alberta government departments, Alberta Innovates corporations and Campus Alberta (which also ensures a more cohesive approach to innovation and technology and policy development), on an as-needed basis.

AI-EES Approach and Operating Principles

AI-EES takes a strategic view, linking knowledge and needs through competitive technology intelligence and scenario analysis. The scenario analysis includes consultations with government departments and agencies, industry, NGOs and other research and development organizations both locally and globally. The AI-EES strategy is based on a clear and realistic diagnosis of the challenges, and application of strong principles and processes.

Linking Knowledge with Solutions

AI-EES' process for defining its programs and priorities is illustrated below. This process has been successful in deploying global knowledge and capabilities to meet the needs of Alberta's energy and environmental sectors. AI-EES staff work with in-house and external specialists to define critical technology gaps and formulate SMART[10] objectives for each gap. Decision-making tools are used to select the most suitable technologies and partners to undertake projects capable of filling the gaps. By focusing resources on technology platforms that offer solutions to a number of gaps and by working in partnership with industry and other research and development organizations, AI-EES gets maximum leverage of government investments to achieve the desired results, impacts and benefits for Alberta. AI-EES implements its plan by collaborating with partners to create strategic programs and projects that will fulfill its mandate.

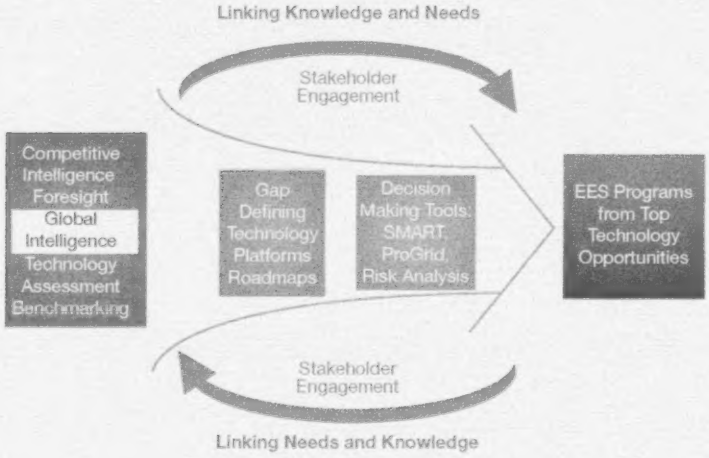


Figure 4: Schematic illustrating the process by which AI-EES defines its priorities and takes coherent actions to achieve the strategic program objectives.

By following a systematic approach, we are able to get the best ideas from around the world, collaborate with partners, involve the right parties at the right time, invest as required and transfer knowledge to Alberta energy and environmental sectors. Our commitment to open innovation means knowledge on clean energy technology is shared to speed up technology development worldwide.

10 SMART: Specific, Measurable, Actionable, Realistic, Timely

Collaboration

As the lead agency for energy and environmental research in Alberta, AI-EES brings together decision makers from government and industry as well as research and technology organizations, to develop solutions for the biggest challenges facing Alberta's energy and environment sector. A fundamental component of AI-EES is to better address government priorities by building stronger synergy and connections among the Alberta Innovates corporations, government ministries, industry groups, post-secondary institutions and other stakeholders. Therefore, we developed our strategic business plan in consultation with these stakeholders.

a. Government of Alberta Departments

AI-EES has established working committees with government departments to discuss specific issues and opportunities involving energy and environment research and innovation and to develop projects that will benefit all parties. We have formalized the "Technology Informing Policy" (TIP) program, through a Memorandum of Understanding that four departments have signed. AI-EES has staff members that regularly meet with counterparts in other departments to delve into opportunities for co-sponsorship of projects. AI-EES has a strong track record of working with other departments on several initiatives, including Carbon Capture and Storage, Advanced Recovery Pilots, Bitumen Royalty In Kind, Life Cycle Analysis and ecoTrust.

b. Relevant GOA Policies and Strategies

AI-EES has studied the following relevant government strategies and identified areas where there are synergies and gaps. By working with the government department responsible for each, AI-EES will build opportunities for future work.

- *Alberta Research and Innovation Plan*, Alberta Advanced Education and Technology
- *Provincial Energy Strategy*, Alberta Energy (December 2008)
- *Responsible Actions: A Plan for Alberta's Oil Sands, Alberta Treasury Board* (February 2009)
- *Alberta's 2008 Climate Change Strategy*, Alberta Environment (January 2008)
- *Renewed Water for Life Strategy,* Alberta Environment (November 2008)
- *Tailings Management Framework*, Alberta Environment (in development)
- *Land-use Framework,* Alberta Sustainable Resource Development (December 2008)
- *Alberta Nanotechnology Strategy*, Alberta Advanced Education and Technology (April 2007)
- *Directive 074 – Tailings Performance Criteria and Requirements for Oil Sands Mining Scheme*, Energy Resources Conservation Board (February 2009)
- Shaping the Future, *Report of the Premier's Council for Economic Strategy* (May 2011)

c. Research, Analysis and Technology Informing Policy

To build and enhance collaboration and leverage resources, AI-EES developed a Memorandum of Understanding with Alberta Energy, Alberta Environment and Water, Treasury Board & Enterprise and Sustainable Resource Development to create a formal mechanism called "Technology Informing Policy" (TIP) for facilitating, coordinating and promoting technology innovations, which are important from a policy development and strategic business planning perspective.

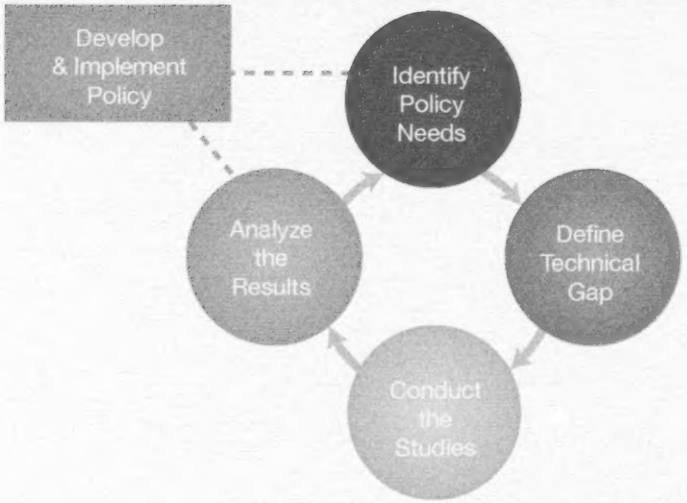


Figure 5: Illustrating the TIP Fund

This mechanism provides the framework for AI-EES to work with key GOA departments to ensure that policy decisions and strategies are informed by sound technical analysis. AI-EES and the departments are involved at all stages of the process. However, development and implementation of policy is done by the relevant ministries, as shown by the dotted lines.

Examples of projects involving research analysis and technology informing policy include:

- Comparison of pipeline corrosivity of dilbit and conventional oil
- Energy, GHG and water flow modelling and valuation of GHG Reductions
- Thermal in situ water conservation study
- End-to-end tailings technology roadmap and action plan
- Economic impact of carbon capture and storage
- Review of Innovative Energy Technologies Program projects using polymers
- Potential for use of CO_2 in tailings
- Centralized coke gasification and chemical cluster study
- Impact of solution culture pH and micronutrient deficiency on Selected Boreal Species for Oil sands Reclamation.

d. Climate Change and Emissions Management Corporation (CCEMC)

The Climate Change and Emissions Management Corporation was established pursuant to *Climate Change and Emissions Management Regulations* under the department of Alberta Environment and Water as a standalone corporation, at arm's length from government. It is a virtual corporation in that all functions are provided by different service providers. AI-EES provides strategic advice, technology adjudication and project management for the CCEMC. AI-EES is intimately involved with, and has staff assigned to participate in, all of the CCEMC funded projects and programs. In many cases, AI-EES has provided funding in early project work, and projects apply to CCEMC for the funds needed to demonstration large projects.

AI-EES is the connector between government direct investments in energy and environment and the indirect investments funded by the CCEMC. This ensures that AI-EES, CCEMC and government are strong collaborators in technology demonstration.

The future Global Energy Centre would certainly build upon these collaborative efforts and include Alberta Innovates, Campus Alberta, GOA and CCEMC. This has the potential to reduce overhead, ensure greater consistency and reduce overlap in funding priorities.

e. Campus Alberta and Alberta Innovates

AI-EES has worked closely with Campus Alberta and Alberta Innovates since their inception. These organizations are important players in building research capacity in Alberta.

AI-EES and Alberta Innovates – Technology Futures have a long history of working together on numerous projects over many years. A partnership with Alberta Innovates – BioSolutions includes work in bio-energy, waste and biomass to produce bio-fuels and biological sinks. Work with Alberta Innovates – Health Solutions will lead to integration of work around healthy aquatic systems and impacts of climate change on humans. These relationships will continue in all strategic areas and programs.

f. Strategic Alignment with Alberta Research and Innovation Plan

AI-EES works in support of the Alberta Research and Innovation Plan. This plan has four priorities: Economic Diversification and Competitiveness, Environmental Stewardship, Social Well-Being and Health, and Talent and Skills. The following list shows examples of AI-EES' work in each priority area.

Economic Diversification and Competitiveness:

- Waste to fuels projects
- Underground coal gasification
- Novel recovery technologies such as electrical heating
- Developing Supercapacitor Energy Storage for Wind Turbine Generators

Environmental Stewardship:

- Roadmap and Action Plan for End-to-End Solutions for Oil Sands Tailings
- Thermal In situ Water Conservation Study
- Linear disturbance reclamation
- Reclamation of surface mine affected area using sandy soil and organic residuals

Social Well-Being and Health:

- Metal precipitation in NE Alberta will seek to answer the question of atmospheric metal emissions from oil sands operations in NE Alberta
- Various projects on water quality, and safe and secure water supplies

Talent and Skills

- Canadian Centre for Clean Coal/Carbon and Mineral Processing Technologies (C5MPT)
- NSERC Industrial Research Chair in Tailings Water Treatment

- NSERC Industrial Research Chair in Oil Sands Processing Water Treatment
- Pacific Northwest National Laboratories /University of Ottawa CO_2 Capture project
- University of Alberta Chair in Energy and Environmental Modeling
- Alberta Helmholtz Initiative on Energy and Environment Research
- Centre for Oil Sands Innovation

g. Industrial Associations and Non-Government Organizations (NGOs)

AI-EES is a member of a variety of associations[11] and provides leadership by sitting on their boards. Staff members regularly interact with their peers in a variety of meetings, technology workshops and conferences.

h. Industry

Most of AI-EES projects have funding from industry partners. AI-EES staff work closely with industry in developing ideas for research and innovation projects and in launching co-funding opportunities. AI-EES Board members have significant industry and business experience and provide strategic leadership and oversight. Board members are often called upon by provincial, national and international organizations to provide advice and are in a position to influence industry and government directions in research and technology.

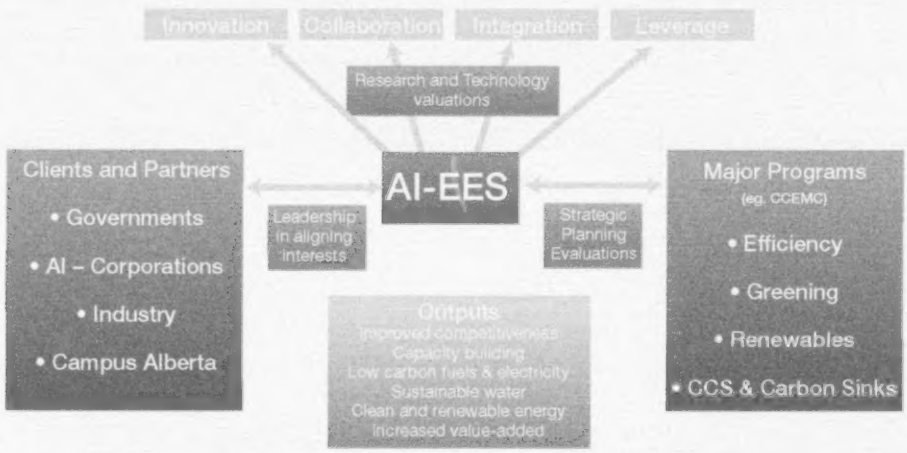


Figure 6: Illustrating the central role that AI-EES plays as the technology arm of both the CCEMC and Alberta government and as a major force in promoting innovation, collaboration and an integrated approach to research and technology.

11 Examples include Alberta Chamber of Resources, Petroleum Technology Alliance of Canada, Carbon Management Canada and Alberta Water Council

Investment Principles

The heart of AI-EES' operations is to evaluate and invest in projects that help AI-EES fulfill its mandate. AI-EES works with partners to develop the projects that will promote Alberta's interests. Projects are evaluated by a committee of AI-EES scientific personnel to determine how well the project meets the criteria for funding.

The following form the key principles for AI-EES investments:

- Secure maximum value from all of Alberta's energy resources, while balancing economic, environmental and social interests
- Improve environmental performance
- Provide science-based information for effective water management
- Reduce the environmental impacts of hydrocarbon extraction and processing
- Increase deployment of clean energy – including renewables
- Increase energy efficiency
- Increase access to, and effectiveness of, energy markets
- Stimulate economic development and accelerate commercialization in Alberta
- Transfer technology to the appropriate sectors
- Inform policy.

Applying these principles will allow us to advance critical technologies to commercial application that will give Alberta a sustainable competitive advantage in world markets.

Selected Outcomes

The table below highlights some of the key outcomes and their impact on Alberta from each of the four strategic areas.

SAMPLING OF OUTCOMES ACHIEVED FROM EACH OF THE STRATEGIC AREAS		
Strategic Area	**Title**	**Impact for Alberta**
Energy Technologies	**Partial Upgrading**	In collaboration with MEG and SDTC, AI-EES is developing and piloting a novel upgrading technology with breakthrough potential. The development supports value-added and netback improvement of Alberta bitumen and the reduction of the industry's current dependency on diluent and natural gas. By converting bitumen to pipeline crude that can be received by traditional refineries, this technology has a substantial potential not only to establish Alberta bitumen as a benchmark crude in global market, but to increase the amount of Alberta bitumen product delivered to market through existing pipeline infrastructure, all done while reducing energy intensity, greenhouse gas emissions, and water reduction.
	Electric Based Recovery Processes	Improving the efficiency and environmental performance of bitumen recovery is a paramount in achieving a clean energy future while maintaining economic strength for the province of Alberta. AI-EES is supporting the development and field testing of electrical based recovery processes with the potential of substantially reducing energy and water consumption, while reducing greenhouse gas and other production emissions. Unlike conventional in situ processes, the electrical methods have the potential of operating at low pressures and thus also have the potential of accessing current mining horizons and the remaining two-thirds of the identified Athabasca resource that is currently to shallow for commercial in situ or to deep to mine.
Renewable and Emerging Resources	**ISCG**	Alberta has more than 2 trillion tonnes of unmineable deep coal resources, which could be unlocked through ISCG to generate clean power, hydrogen, liquid fuels and petrochemicals. The carbon dioxide generated could either be used for enhanced oil recovery or sequestered
	Waste to Value-Added	Albertans produce 20 million tonnes of waste to be landfilled annually. Mixtures of co-mingled plastics and biomass residues, derived from municipal solid waste, could be gasified and the syngas could be used to produce power, alternate fuels and chemicals. This initiative contributes to the AI-EES 2020 target of increasing the renewable energy share in order to supply 20% of Alberta's power generation, while reducing greenhouse gas emissions by 10-15% from this sector.

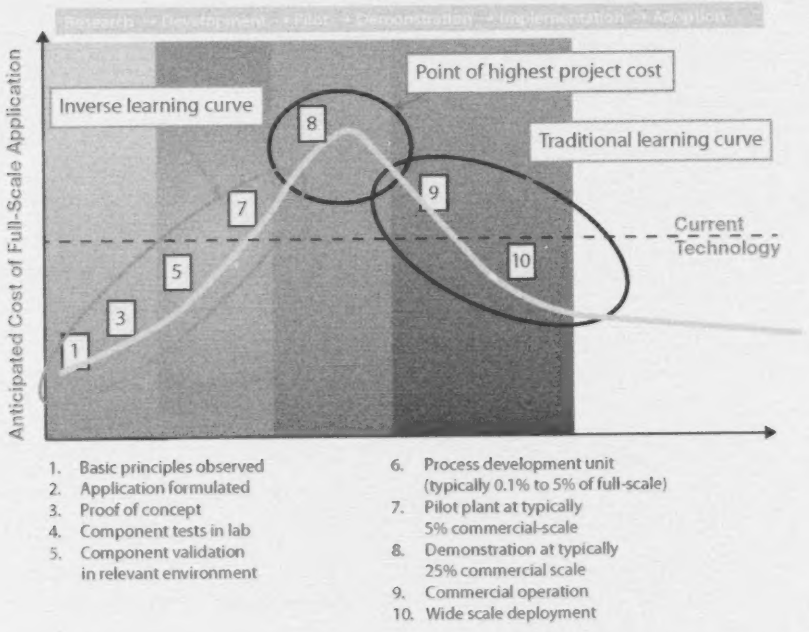
Environmental Management	**Oil Sands Tailings Technology Deployment Roadmap**	In collaboration with Oil Sands Tailings Consortium (OSTC), Alberta Innovates – Energy and Environment Solutions (AI-EES) is developing an Oil Sands Tailings Technology Deployment Roadmap and Action Plan. Evaluating over 400 ideas and 100 technologies around the globe, the study identifies promising technology pathways for near term deployment based on technical, environmental, social and economic merits. It will help achieve more timely information/knowledge sharing and deployment of the end-to-end solutions for oil sands tailings.
	Enabling Carbon Capture and Storage (CCS) in Alberta	CCS is an integral part of Alberta's Climate Change Strategy. AI-EES has been collaborating with Shell on their Quest project to find a secure geological site for CO_2 storage in the Western Canadian Sedimentary basin. AI-EES is now focusing on developing advanced capture technologies that will carbon capture economic for enhanced oil recovery.
Water Resources	**Wetland Health: Challenges and Opportunities in Implementing Alberta's Wetland Policy**	Wetlands perform critical functions as part of the hydrologic cycle. Research funded by AI-EES (Water Resources) has brought together leading natural and social science disciplines to develop evidence-based tools that will support the development of policy, regulatory and management activities to better manage wetlands within the Alberta landscape. The integration of field-based research with advanced remote sensing technologies has enabled a regional approach to wetland assessment and management that is useable by provincial and local government decision-makers.
	The Dynamics of Alberta's Water Supply	Taking a province-wide view of Alberta's water supplies to answer questions such as; how much water is there, where is it, when is it, how is it used, and what are the risks and vulnerabilities was key to assembling an international team to better understand the dynamic nature of the province's water resources. This project allowed for an analysis of historical water supplies and trends by sub-watershed, an overview of ground water resources, analysis of the contributions of glaciers and employed international recognized models to better understand the full hydrologic cycle in Alberta. Information generated by the project fits into Alberta's strategic directions related to regional land use planning and implementation of cumulative effects management decision-making.

Monitoring for Success

AI-EES evaluates projects and tracks their success by assessing their Technology Readiness Levels (TRL) relative to progress and milestones achieved (see Figure 7); each project is tracked to see how it progresses through the various levels of readiness. This allows AI-EES to maintain a balanced portfolio of projects along the commercialization continuum; keeping a number of projects entering the spectrum at the early ideas stage and developing technology transfer strategies when projects move closer to commercialization.

AI-EES is investing taxpayer's dollars in projects. It is imperative that the maximum value of those investments be realized. The best way to do this is to take a very hands-on approach to project monitoring. AI-EES creates a steering committee for all projects in which it invests; personnel sit on the steering committees and regularly interact with project performers; and the organization receives regular project reports. AI-EES does not release funds until reports are read and analyzed by staff. This applies to all CCEMC funded projects as well.

This process requires that staff have detailed knowledge in their area of expertise, so that they are seen as important additions to a project steering committee team. This requires that key personnel in AI-EES have advanced degrees and have developed a reputation built on trust and knowledge with their peers. Large pilot projects, in which investments of several millions of dollars are made, require weekly and sometimes daily communications with the research performer to ensure that the project has what it needs to be operationally successful. Therefore, adequate staff and a network of consultants are required to do this task correctly and to ensure the safeguarding of government investments.



1. Basic principles observed
2. Application formulated
3. Proof of concept
4. Component tests in lab
5. Component validation in relevant environment
6. Process development unit (typically 0.1% to 5% of full-scale)
7. Pilot plant at typically 5% commercial-scale
8. Demonstration at typically 25% commercial scale
9. Commercial operation
10. Wide scale deployment

Figure 7: Illustrating the Technology Readiness Levels modified from those of the Electronic Power Research Institute. The curve is a better representation of technology development than the conventional "S" curve. A similar approach can be taken with projects that advance knowledge gaps to inform policy directions or to improve environmental performance.

Portfolio Analysis

As of December 31, 2011, the 60 active projects in the AI-EES portfolio were analyzed and placed on the simplified Technology Readiness Levels going from **research** to **development** to pilot to **demonstration** to **commercialization** to **widespread adoption**.

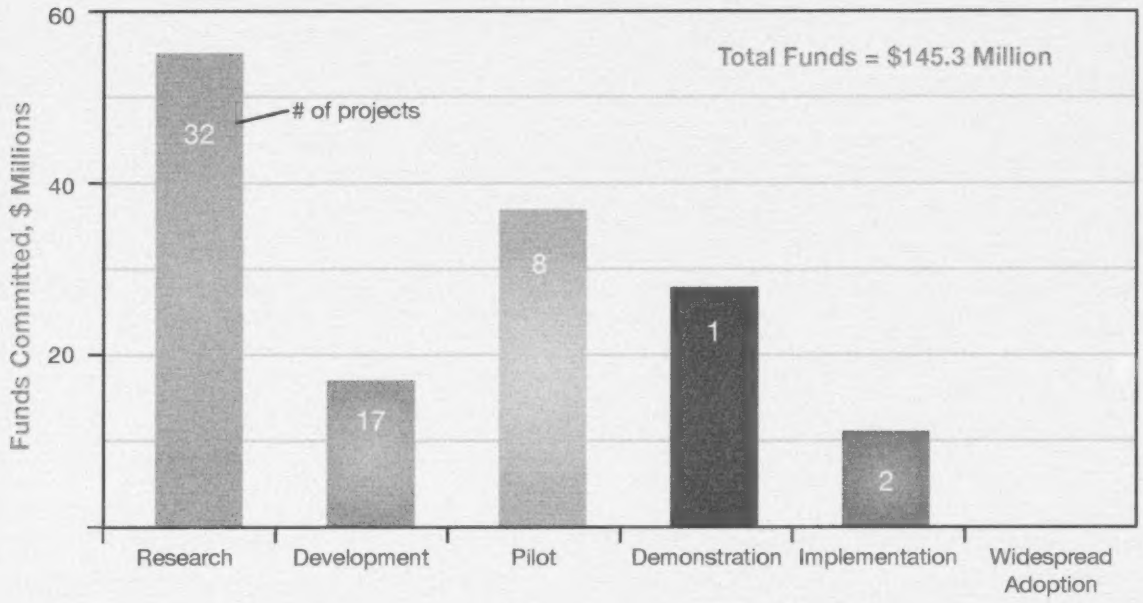


Figure 8: Mapping AI-EES' 60 active projects along the innovation path. It is estimated that of the 60 projects, 21 are ready to move to the next stage of development with the majority of the 21 projects being from the development and pilot stages.

AI-EES also tracks the balance of projects as broken down by the four strategic areas. The chart below looks at the same 60 projects and the total $145.3 million investment in innovation and the relative percentage of funding to each strategic area. AI-EES strives to maintain a balanced portfolio across the four areas.

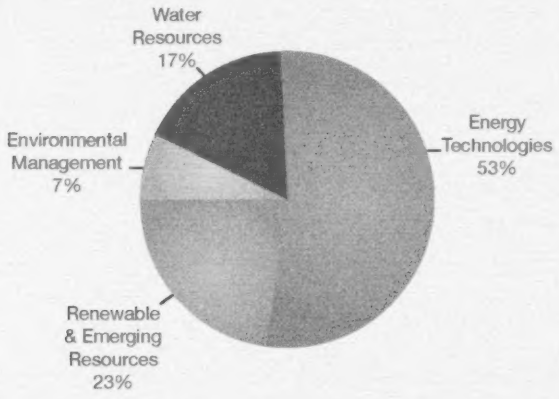


Figure 9: Illustrating the funding profile of the 60 active projects across the four strategic areas.

Alberta Innovates System Collective Outputs and Measures

AI-EES has used ProGrid for tracking its corporate progress towards long term targets. More specific performance measures are under development. One potential tracking method is to look at tracking technology readiness and advancement of projects along the technology continuum as a means of showing that the AI-EES investment in projects is advancing technology towards commercial development.

AI-EES is also looking at performance measures related to the relative amount of funding for each strategic area. Two other performance tracking methods are described below.

In fall 2011, the Alberta Innovates corporations agreed to report on four performance measures that highlight the collective work of the corporations. These are:

MEASURE	DEFINITION
Collaborations	Proportion of corporations' work that was undertaken collaboratively
Talent, Researcher, Innovators, Entrepreneurs	Number of people supported through Alberta Innovates' programs and services focused on development of Highly Qualified or Highly Skilled People (HQ/SP)
Knowledge Mobilization: Innovations	Number of innovates/solutions implemented in past fiscal year
Investments in Research and Innovation	Investments anticipated to result in innovations or solutions in four years or less

2011-12 is the first year that the Alberta Innovates corporations will collect this data on these collective measures. Targets for future years are being created.

ProGrid Business Tracking

AI-EES uses the SMART Objectives Evaluation Matrix (based on the ProGrid® methodology) to measure progress, track its long term progress on goals and ensure that government investments are spurring advancements toward long-term targets.

Progress within each strategic and program area is measured annually identifying the Innovation Capacity and the Innovation Impact achieved by AI-EES over a period of time.

The high level evaluation matrix that AI-EES is using at the highest level evaluates eight criteria.

INNOVATION CAPACITY	ENABLERS	INNOVATION IMPACT
Energy Strategies	Management Capacity	Energy Technologies
Environmental Strategies	Partnerships	Environment Management
	Funding	Renewable and Emerging Resources
		Water Resources

Results for 2011-12 will be shown in the Annual Report in June 2012.

Going forward, AI-EES is developing a plan to measure progress on goals for each of our strategic areas.

The chart on the left shows the rating for the corporation as a whole. The chart on the right shows the position of each of the four strategic areas in relation to achieving the 2030 targets.

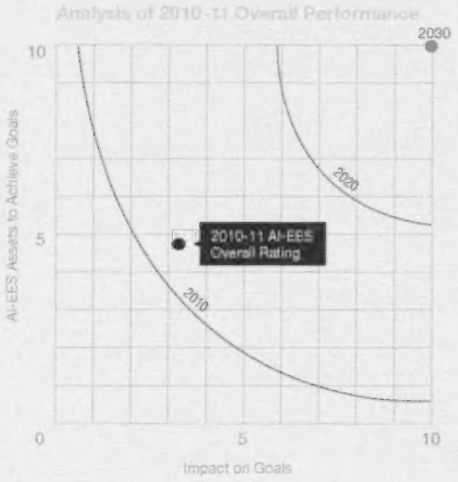


Figure 10: Level Zero Performance Grid shows the 2010-11 position of AI-EES in meeting long term targets.

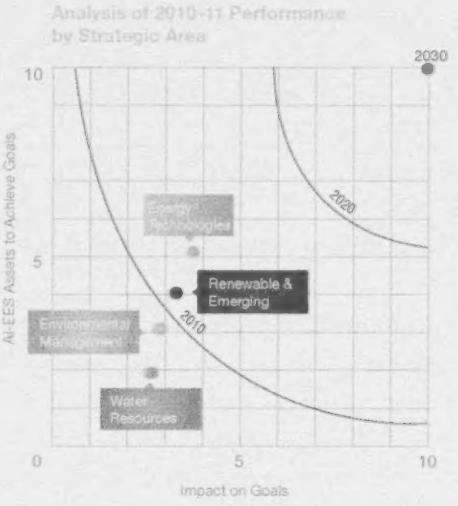


Figure 11: The Level One Performance Grid shows the aggregate performance of all initatives within a Strategic Area and how they are helping AI-EES reach its Targets.

Budget

Reaching the targets outlined in this strategic business plan requires sustained, planned and increased resources for energy and environmental innovation, and the integration of research efforts across government, industry, research providers and universities. Substantial funds are made available to a variety of agencies throughout government for energy and environment research.

Alberta Innovates – Energy and Environment Solutions 2012-15 Budget

(in thousands)

	Comparable					
	2010-11 Actual	**2011-12 Budget**	**2011-12 Forecast**	**2012-13 Estimate**	**2013-14 Target**	**2014-15 Target**
REVENUE						
Funding from AET[1]	19,325	18,525	18,525	17,660	16,010	16,010
Revenue Recognized from AWRI Grant[2]	7,127	6,944	4,139	2,383	6,255	120
Funding for Water and Tailings Research	–	–	–	4,440	5,060	5,730
Funding from CCEMC[3]	742	1,000	800	2,628	2,628	2,628
Industry Funding	108	–	3,370	756	756	756
Investment Income[4]	415	200	479	300	300	300
Other Revenue	651	700	307	50	50	50
Total Revenue	28,368	27,369	27,620	28,217	31,059	25,594
EXPENSES						
Energy Technologies	7,291	9,453	4,986	12,252	6,175	3,675
Environmental Management	2,233	2,023	2,395	4,711	4,120	4,120
Renewable and Emerging Resources	920	5,710	918	6,550	8,725	3,225
Water Resources	6,460	6,156	3,318	6,996	10,255	4,120
Administrative Costs	3,136	3,457	4,093	4,502	4,387	4,453
Technology Support[5]	1,663	1,570	2,645	1,943	1,798	1,955
Total Expenses	21,703	28,369	18,355	36,954	35,460	21,548
Net Operating Capital	6,665	(1,000)	9,265	(8,737)	(4,401)	4,046
CAPITAL INVESTMENT AND NET CHANGE IN CAPITAL ASSETS						
New Capital Investment and Inventory Acquisitions	76	72	68	64	60	56
Less: Amortization of Capital Assets	(4)	(4)	(4)	(4)	(4)	(4)
Commercial Leases	–	–	–	–	–	–
Increase (Decrease) in Capital Assets	72	68	64	60	56	52
CHANGE IN NET ASSETS						
Net assets at Beginning of Year	7,735	14,400	14,400	22,465	9,308	693
Net Operating Result for the Year	6,665	(1,000)	9,265	(8,737)	(4,401)	4,046
Less Contingency Fund[6]	–	–	–	(4,420)	(4,214)	(4,348)
Less Allowance for Wind-up Costs	–	–	(1,200)	–	–	–
Increase (Decrease) in Net Assets	14,400	13,400	22,465	9,308	693	391

Notes:

1. Per Budget 2012.
2. Allocation of $13.7 million available at March 31, 2011 – assumes no new funding for AWRI.
3. Reimbursement of expenses includes revenues from providing services to the CCEMC.
4. Interest is estimated at a 1% interest rate.
5. CCEMC expenses for reviewers, other peer reviews, purchase of specialized studies, scientific consultants.
6. AI-EES will retain minimum carryover of 20% of Funding from AET and Funding for Water and Tailings Research as a contingency fund for reduction in budget and potential wind up costs.

Budget by Key Outcomes

(in thousands)

Priority Area*	Total 2012-13 Budget	Key Outcomes of the Alberta Research and Innovation System		
		Effective Resource & Environmental Management	Broadened Economic Base	Resilient, Healthy Communities
Energy Technologies	12,252	6,126	6,126	–
Environmental Management	4,711	3,769	942	–
Renewable and Emerging Resources	6,550	1,310	5,240	–
Water Resources	6,996	1,749	–	5,247
Grand Total	**30,509**	**12,954**	**12,308**	**5,247**

Appendix A
Energy Technologies

Context

Alberta is blessed with immense hydrocarbon resources which will serve the energy needs of the world for the foreseeable future. The Exxon Mobile Outlook of 2012 predicts that over 80% of energy needs will be met by oil, gas and coal until at least 2040.

Alberta's energy resources require novel technologies for efficient, clean extraction and production and to improve the quality of the derived products. To produce the resources, more energy is required, and that means that there is greater production of emissions and use of water. The world is demanding that energy resources be developed in a clean, environmentally sustainable manner.

Vision

Alberta will be a global leader in adapting and integrating technology and knowledge for the effective and environmentally sustainable production, processing and utilization of unconventional hydrocarbon resources and low-value carbon sources for transportation fuels, petrochemicals and power generation with minimal impacts on land, water, and air.

2020 Goals

Energy Technologies overarching goal is to ensure Alberta has the necessary suite of environmentally and economically sustainable technologies to support the continued growth of the hydrocarbon energy and products industry.

By 2020, AI-EES will achieve the following key goals:

- Identify new game-changing concepts and work with qualified industry partners to advance the commercial readiness of most promising technologies
- Development of environmental benchmarks and efficiency opportunities for recovery applications.
- Demonstration of novel recovery technologies that improve the overall environmental performance by reducing CO_2 emissions, water usage and the associated land disturbance over current commercial production practices
- Demonstration of novel recovery technologies that allow commercial accessibility and recovery of intermediate depth, thin pay, stranded and carbonate resources
- Demonstration of one or more integrated in situ recovery and field upgrading processes
- Identification and development of research and demonstration of value-added opportunities from current operations and processing of by-product and waste streams
- Demonstration of one or more clean carbon/coal facility converting low grade feedstocks into clean products.

Strategic Considerations

There are resource drivers:

- Conventional oil production in the Western Canada Sedimentary Basin (WCSB) has been in decline, but is currently enjoying a resurgence in production levels. Many of the conventional heavy oil resources are difficult to produce. The oil sands currently produce two-thirds of Alberta's output of oil, but we are tapping only a small fraction of the resource. Alberta has vast bitumen resources contained within carbonate reservoirs, in reservoirs that are too deep to mine yet too shallow or too thin for standard in situ techniques, and in under-pressurized and marginal reservoirs. Alberta has an estimate 800 year supply of coal. The opportunities:

There are market drivers:

- There is a growing demand for clean electric power. Competing products and production from other jurisdictions are more economically viable. There is market saturation of bitumen products. There is a need to increase product diversity from oil sands.

There are technology drivers:

- Current recovery methods are energy intensive, consume large amounts of water and natural gas, and create a large environmental footprint. Reducing the complexity and energy intensity of upgrading is required. The costs of current CO_2 capture technologies needs to be addressed. Alberta has a need to build new power plants and replace aging power plants. Current methods of conventional drilling, completions and reservoir access have limited efficiency.

Energy Technologies is about addressing these drivers and creating opportunities that will:

- Increase reserves and recovery of heavy oil and bitumen resources
- Improve environmental sustainability of current production and processing practices
- Develop new generation of recovery and processing technologies to reduce energy consumption, water use, emissions and greenhouse gases
- Introduce advanced CO_2 capture and utilization technologies
- Develop advanced catalysis and methods and reduced emissions from producing hydrogen for bitumen upgrading and processing
- Improve product quality and marketability
- Integrate processes for efficiency and reduce capital requirements
- Convert waste byproducts (for example petroleum coke) into value-added products
- Evaluate and apply biomass co-firing in existing coal plants
- Increase unconventional gas recovery and reserves
- Create new environmentally sustainable technologies that allow commercial recovery from new reservoirs.

Energy Technologies has designed three programs to examine these opportunities for implementation in Alberta.

- Recovery and Processing
- Clean Carbon
- Evaluation & Development

Recovery and Processing

AI-EES is supporting the development and demonstration of key technologies that will be incorporated into two or more pilots/demonstrations of sustainable bitumen and heavy oil recovery and processing and upgrading technologies. Initiatives include:

- Research and piloting next generation heavy oil and bitumen extraction and recovery technologies:
  - Centre for Oil Sands Innovation (COSI)
  - Electrical recovery processes for in situ bitumen
  - Alberta Innovates Core Industry research program (AACI) in situ recovery program
  - Low pressure recovery processes
  - Advanced fluid properties and processability
  - Advanced drilling and completions for unconventional hydrocarbon resources
  - Integrated field upgrading and extraction processes
  - Evaluation and management of Climate Change and Emissions Management (demonstration projects).
- Research into piloting next generation upgrading and conversion technologies:
  - Hydrocarbon Upgrading Demonstration Program
  - AI-EES/NRCan CanmetENERGY Upgrading National Center for Upgrading Technology research and development program
  - Novel primary and secondary upgrading processes
  - Production of hydrogen with reduced carbon footprint for use as a feedstock or fuel.
  - Advanced lower cost gasification processes for processing residues
  - Novel processes for producing petrochemical feedstocks from bitumen-derived streams

Clean Carbon

AI-EES is supporting the development and demonstration of the key technologies that will be incorporated in one or more clean coal/carbon demonstration plants converting low-value fuels into electricity, hydrogen, heat and chemicals with minimal adverse impact on the environment and the capability of capturing CO_2. Initiatives include:

- Canadian Clean Power Coalition (CCPC) research and development program
- Evaluation of next generation gasification, gas cleaning, CCS, and power generation technologies
- Coal beneficiation
- Canadian Centre for Clean Coal/Carbon and Mineral Processing Technologies (C5MPT)
- Research and development on the conversion and utilization of coke, coal biomass and blended feedstocks
- Underground coal gasification with CCS
- Joint program with NRCan/CanmetEnergy on advanced polygeneration technologies for converting low grade coal, oil sands coke and petroleum residues into high value fuels and chemicals.

Evaluation and Development

AI-EES monitors the industry outlook and is supporting the development and review of key technologies for future recovery opportunities. Initiatives include:

- University of Calgary Tight Gas Research Chair
- Resource characterization studies in commercial process optimization and transition, tight oil, shale gas and marginal resources
- Development of industry best practices
- Economic feasibility studies.

Key Messages:

- Alberta's continued prosperity relies on the energy sector which includes conventional oil and gas, unconventional gas and oil sands
- In order to improve the recovery performance and overall sustainability of hydrocarbon development in Alberta, it is imperative that new technologies be developed to allow a successful transition from current commercial processes
- The Government of Alberta, AI-EES and industry continue to work together to identify, and investigate a variety of potential technology development and technology integration opportunities to increase efficiency and to improve economic competitiveness
- Alberta is becoming recognized as a world leader in adapting and integrating technology and knowledge for the effective utilization of its coal, coke and other low-value carbon fuels as an energy source for the production of electricity, heat and chemical feedstocks with minimal environmental impacts
- Alberta has an abundance of coal, coke, oil sands, refinery residues and biomass that could be converted to higher value products through new and improved technologies
- Technology development is necessary for expanding bitumen markets, for creating high quality jobs in Alberta, and to increase the value-added processing capacity of Alberta's petrochemical industry
- Increased recovery and value-added processing need to be accomplished in an environmentally responsible way – this is a key to sustainable prosperity for Albertans.

Appendix B
Renewable and Emerging Resources

Context

Long-term energy outlooks agree that, as energy demand surges, while oil and gas supplies dwindle, renewable and emerging energy resources will play an increasingly important role in the global energy mix: Alberta must stay engaged in these technologies, where it has a natural advantage. Alberta has large biomass, wind, solar and geothermal resources, as well as world-class deep coal deposits. Timely "innovation" investment in this area could lead to new industries, a revamped manufacturing sector, renewable energy infrastructure, trained professionals and rural sustainability.

The overarching Renewable and Emerging Resources (RER) goals are to ensure that:

- Our initiatives contribute towards the Premier's vision of making Alberta a global energy centre and support accelerated deployment of our renewable and emerging resources, in order to augment and sustain our oil and gas production
- RER is aligned with the Government of Alberta's strategies pertaining to the diversification of energy supplies, mitigating greenhouse gas emissions and value-added products
- AI-EES maintains a flexible approach and strategically positions itself to take full advantage of renewable and emerging energy technologies which show the greatest promise in terms of economic and environmental impact in Alberta.

Vision

Energy production is increasingly augmented from our renewable and emerging energy resources, which are the key to a smooth transition to a Zero Carbon Economy.

2020 Goals

- Based upon an annual growth rate of 10% or better, by 2020, energy production from renewable and emerging resources will supply 20% of Alberta's power generation, resulting in a 10-15% reduction in greenhouse gas emissions from this sector
- Successful completion of two or more geothermal, bioenergy wastes-to-fuels and underground coal gasification demonstration projects.

Strategic Considerations

- There is strong global growth in renewable and emerging energy sectors
- Significant renewable and emerging resources are available in Alberta
- Significant quantities of municipal and industrial wastes are produced in Alberta, which could be converted to power, biofuels and other value-added products
- Increasing production from renewable and emerging resources will help Alberta reduce its greenhouse gas (GHG) emissions
- Build upon momentum from a successful underground coal gasification field pilot.

By addressing some of these drivers, Alberta could realize the following opportunities:

- Create new industries in areas such as geothermal, underground coal gasification, biomass-to-liquid fuels, gasification of municipal solid wastes

- Develop rural jobs and decentralized energy production
- Convert agricultural, forest and municipal wastes to energy resulting in GHG reductions of 15 million tonnes annually
- Apply emerging technologies such as nanotechnology and advanced thermal processes and potentially further reduce GHG emissions.

Programs

Renewable Energy

Demonstrate novel geothermal and bioenergy technologies which utilize municipal solid waste, forestry and agricultural residues, and produce power, hydrogen and liquid fuels. By 2030, Alberta has a strong and diversified renewable energy manufacturing sector which provides high-paying technical jobs in rural communities.

Initiatives

- Waste to fuels demonstrations including the Edmonton Advanced Energy Research Facility and small, decentralized waste to fuels pilots throughout rural areas
- Detailed geothermal mapping and creation of roadmaps to encourage the development of geothermal field trials
- Advanced energy storage to allow greater deployment of renewable energy
- Developing hydrogen from alternatives and accessible sources such renewables (biomass, solar) and nuclear energy, and including hydrogen separation and CO_2 storage
- Modeling to assist government in creating policies and regulations that would accelerate the deployment of energy efficient and renewable energy technologies that would reduce Alberta's GHG emissions
- Develop two or more nanotechnology innovation initiatives in the energy and environmental sectors.

Emerging Resources

Demonstrate novel underground coal gasification technologies, with carbon capture and storage and develop new technologies that convert syngas to fuels and other value-added products. By 2030, Alberta is a global leader in underground coal gasification and other alternate energy technologies

Initiatives

- Underground coal gasification pilots to create value from deep coal resources that cannot be mined
- Investigate the use of nuclear fusion and fission in electricity and oil sands production.

Key Messages

- Alberta will constantly monitor major global initiatives in the renewable and emerging resources areas – and when the timing is right, bring such innovations to our province, in support of a resurgent manufacturing sector that brings new, sustainable jobs especially to our rural areas
- AI-EES will foster collaboration and partnership with industry, organizations and government research laboratories worldwide to adopt/adapt/apply renewable and emerging resources technologies that are clean, sustainable and would meet our future needs
- Alberta has the potential to be a leader in waste management and utilization. This new industry would help Alberta's energy industry to gain a reputation on providing positive solutions to environmental, economic and social challenges associated with wastes while meeting Alberta's goals to produce renewable energy and value-added products from primary sources
- The timing is right to re-assess the importance of hydrogen to our economy, since Alberta is one of world's largest hydrogen producers and consumers. Alberta has all the ingredients necessary to establish itself as a global leader in hydrogen production technologies from these sources
- AI-EES's renewable energy R&D portfolio will also focus on Alberta's other renewable resources, specifically biomass and geothermal, to ensure a fully diversified renewable energy mix that can be reliably available to meet a significant proportion of the province's energy needs.

Appendix C
Environmental Management

Context

In today's world the challenges and opportunities in energy and environment are closely interconnected. The production, processing and use of energy resources will always lead to some environmental impacts, be it water consumption, greenhouse gas (GHG) emissions, or land and ecological disturbance.

A goal of AI-EES' Environmental Management programs is to develop the technologies and management practices to balance resource development and environmental protection. This is the essence of sustainable development.

Vision

Alberta is a global leader in environmental management and sustainable resource development.

2020 Goals

Environmental Management's overarching goal is to ensure Alberta has the best environmental technologies and management system for a sustainable economy.

By 2020, AI-EES will have enabled the following:

- The rate of increase in mature fine tailings (MFT) accumulation has been reduced and the volume of legacy MFT is on the decline; oil sands tailings water is treated for environmental release; tailings affected oil sands mined areas are being progressively reclaimed
- Water recycle rate will be over 90% in thermal in situ recovery of bitumen. Fresh water use intensity in situ oil sands production will be reduced by 50% compared to 2005
- Alberta has instituted best management practices for air, water, land and biodiversity
- Alberta has met its 2020 GHG emission reduction goal (50 Mt/y reduction)
- The well-to-tank (WTT) carbon intensity of bitumen-derived fuel is equal or lower than the average of U.S. domestic and imported petroleum fuels.

Strategic Considerations

- The rate of energy resource development in Alberta may have outpaced environmental and social acceptance of the energy industry. Major concerns include GHG emissions, growing oil sands tailings ponds, water consumption, air quality, land usage, and biodiversity
- Sustainable hydrocarbon production places a greater emphasis on environmental performance of the highest standards through regulatory and monitoring systems, world-class research, and technical innovation and collaboration
- Alberta's economy depends on energy exports but they must be perceived to be clean. Alberta's achievements and leadership in environmental protection and sustainable development have to be recognized internationally, especially by our existing and future trading partners
- Reducing GHG emission in oil sands production would help the market access of bitumen-derived fuels. However, options for GHG reduction are limited. Carbon capture and storage (CCS) could be an option but the cost for carbon capture is still too high
- Current bitumen and SCO production technologies are energy- and water- intensive. Surface mining causes major land disturbance and generates large quantities of tailings, an environmental liability. Biodiversity and wildlife habitat (both in surface mine areas and in linear corridors related to in situ recovery) are affected. Land reclamation in these areas is a long process. Emissions from tailings ponds (methane), and bitumen upgrading (metals, odor) and refining are also of concern.

Environmental Management is about addressing these drivers.

AI-EES has designed three programs to focus our effort toward achieving the strategic goals of the Environmental Management area:

- Oil Sands Tailings and Water Management
- Enhanced Ecology (Environmental Monitoring, Land Reclamation, Biodiversity, Life Cycle Analysis, and Sustainability Index)
- Carbon Capture and Storage (CCS).

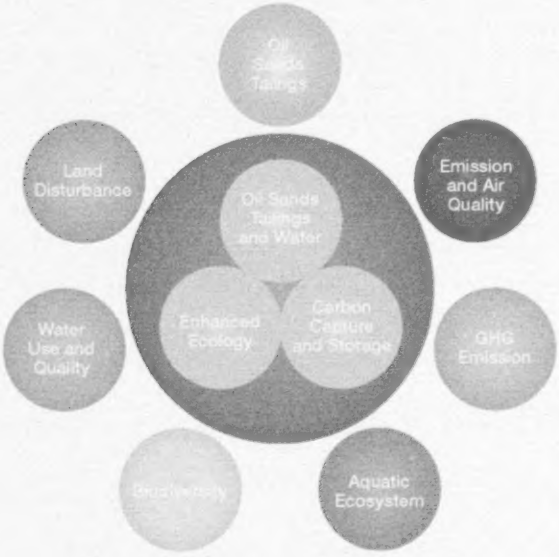


Figure 12: Key environmental issues in Alberta (outer circles) and three Environmental Management programs at AI-EES (inner circles) to address changes.

Oil Sands Tailings and Water Management

The Oil Sands Tailings and Water Management program aims to enable the industry to achieve the long-term objectives set out by Energy Resources Conservation Board and Alberta Environment and Water. The knowledge gained by AI-EES' participation in this R&D is made available to policy makers and regulators for effective tailings management policy and regulation development. The program has the following foci:

- MFT treatment and solidification technology development and demonstration
- Tailings water treatment technology development and demonstration
- Tailings solids reclamation
- Thermal in situ water conservation.

Our current flagship projects include:

- Roadmap and Action Plan for End-to-End Solutions for Oil Sands Tailings
- Thermal In situ Water Conservation Study
- NSERC Industrial Research Chair in Tailings Water Treatment
- NSERC Industrial Research Chair in Oil Sands Processing Water Treatment

More projects are being developed:

- The Roadmap and Action Plan is expected to lead to a number of field demonstration projects
- Terrestrial and wetland reclamation of dried fine tailings
- Saltworks steam assisted gravity drainage (SAGD) water treatment process
- Evaluation of a number of water treatment technologies

Enhanced Ecology

The Enhanced Ecology program is designed to provide environmental stewardship for Alberta through research and technical innovation and collaboration. The program will focus on:

- Environmental monitoring (air, water, and land use) technologies
- LCA for oil sands development, power generation, renewable and emerging resource utilization
- Land Reclamation and Management
- Biodiversity management
- Sustainability index development.

With the exception of LCA studies, most initiatives in this program are new. A strong and coherent program is emerging. Important initiatives include:

- Linear disturbance reclamation to address land fragmentation and biodiversity issues related to in situ oil sands development and infrastructure (e.g., pipeline) development
- Reclamation of surface mine affected area using sandy soil and organic residuals
- Metal precipitation in NE Alberta to answer the question of atmospheric metal emissions from oil sands operations
- Environmental issues related to bitumen transportation
- LCA studies of oil sands technologies and biofuel pathways
- AI-EES continues to watch for the opportunity to revive the development of a Sustainability Index for Oil Sands.

Carbon Capture and Storage (CCS)

AI-EES' CCS program consists of four core technologies:

- Carbon capture technologies including chemical absorptions, dry absorption, and membrane separations
- CO_2 enhanced oil recovery (EOR)
- Carbon storage in saline aquifers
- Monitoring, measuring, and verification (MMV).

Our technology focus has shifted from carbon storage to carbon capture in the last year. Further, we have made carbon capture a focus in the CCEMC program. Through the combined efforts of AI-EES and CCEMC, our key CCS projects include:

- Shell Quest CCS project
- Swan Hills Synfuels project
- Basal Aquifer project
- HTC Purenergy/Devon Energy CO_2 Capture from OTSG FEED Study
- GE/UA/AITF Pre-Combustion CO_2 Capture project
- Suncor Oxyfuel Demonstration project

More carbon capture projects are being developed at AI-EES and CCEMC:

- PNNL/University of Ottawa CO_2 Capture project
- Cenovus Chemical Looping Steam Generating project
- Inventys/NOVA Chemicals/Pennwest Joffre CCS project
- Husky/HTC Purenergy CO_2 Capture from OTSG Demonstration project
- Enhance Energy/ATCO Prometheus CO_2 Capture project
- Enzyme catalyzed Carbon Capture projects

In addition to focusing on carbon capture, AI-EES will take the initiative to identify and help removing barriers in CO_2 enhanced oil recovery.

Key Messages

- Alberta is investing in technologies to protect our environment for future generations
- AI-EES is developing the framework and tools to measure environmental performance to address the concerns regarding the overall environmental state of Alberta and the environmental impacts of its resource industry, in particular the oil sands industry
- Alberta's government is taking strong actions on oil sands tailings management, starting with a roadmap and action plan. This roadmap will become a key strategic planning document for both AI-EES and the OSTC for the demonstration and commercialization of tailings technologies
- AI-EES is supporting the development of key technologies that will enable the industry to reduce its freshwater use by 50% by 2020

- Life Cycle Analysis and Sustainability Indices will promote best sustainable practices among industries. More importantly, it will provide the government with a tool to make decisions affecting the long-term sustainability and prosperity of Alberta
- Alberta is a world leader in adapting and integrating technology and knowledge for Carbon Capture and Storage. AI-EES is leading the effort to remove the key barriers in carbon capture and CO_2-EOR. This, together with energy efficiency and renewable energies, can reduce CO_2 emission by 50 Mt/annum by 2020 as stated in Alberta's Climate Change Strategy
- Overall, AI-EES will play a key role in positioning Alberta as a global leader in sustainable hydrocarbon and renewable energy production.

Appendix D
Water Resources

Context

Water is a key underpinning of Alberta's development. Resolving the challenges related to water – its availability or scarcity, its quality, its impact on the health of Albertans, its use by industry, and its role in sustaining healthy environments – will be compelling factors in decisions that shape the future of the province. Ensuring Alberta has the quality and quantity of water, where it is needed and when it is needed to support our quality of life, the health of our communities, families, economy and the environment is the impetus behind the Water Resources strategic area.

Vision

Alberta is globally recognized as a leader in managing its water resources for people, the environment and the economy.

Strategic Considerations

Water in the energy, agricultural and environmental sectors is a formidable driver for innovation and technology development. Alberta is in an enviable position for exports in water technology and advanced management concepts. However, this potential 'head-start' position is at stake if Alberta does not capitalize on its position and become actively engaged in the global dialogue and aggressively promote Alberta's know-how, and its technological and societal solutions.

To assure the Province's future wealth and environmental prosperity, AI-EES must concentrate on:

- Securing water for people, the environment and the economy; reducing the risk of insufficient quality and quantity of water, particularly with respect to Alberta's demographics and global change impacts
- Supplying sufficient good quality water to vulnerable segments of society, for critical environments and sensitive ecosystem functions, specifically in times of scarcity
- Promoting inclusive, comprehensive and collaborative watershed stewardship and ecosystem management to serve all stakeholders within a watershed
- Improving conservation, efficiency and productivity of water use.

Programs

Water Security, Risk & Vulnerability

- Ensure Albertans have ongoing secure access to 'safe' water for people, nature and the economy. This requires expanded knowledge and an improved understanding of the qualitative and quantitative aspects of Alberta's dynamic water supplies, storage systems and the interaction between surface water and groundwater systems
- Capitalize on new approaches and technologies to collect, analyze and interpret water data and build the information and knowledge for ongoing adaptation to changing conditions
- Develop a focused approach to the unique water security issues for rural Albertans and aboriginal communities

Initiatives include:

- Safe, Secure, Water Supplies for Alberta
- Accelerated De-watering of Oil Sands Fine Tailing through Biological Densification
- Iron Treatment: A Potential Remediation Strategy for Alberta's Eutrophic Fresh Waters

- Dynamics of Alberta's Water Supply
- Conjunctive Use of Surface Water and Groundwater
- Safe Reuse Water, and Fish Bio-Monitoring
- Enabling Integrated Source Water Supply and Protection in Alberta
- Purification of Oil Contaminated Water with Geomorphic Molecular Sieve Membranes
- NSERC Industrial Research Chair in Water Quality Management for Oil Sands Extraction
- Future Water/Wastewater Infrastructure
- De-oiling of SAGD Produced Water using Surface-Modified Ceramic Membrane.

Watershed Stewardship & Ecosystem Management

- Develop a comprehensive scientific understanding of the opportunities to meet and improve the health of aquatic and riparian ecosystems while meeting other critical water needs in society and the economy. Watershed stewardship and ecosystem management rely on a sufficient amount of high quality water at specific times and in specific places. Seasonal, meteorological and climatic changes affect the availability of water
- Promote improved and sustainable water management outcomes through collaborative and integrated decision-making processes with openly accessible scientific data collection and analysis focused on basin-specific goals and objectives.

Initiatives include:

- Water Allocation & Management
- Integrated Watershed Management/Modelling Framework Pilots
- Wetland Health: Challenges and Opportunities in Implementing Alberta's Wetland Policy Rivers for Life: Advancing In-stream Flow Assessment Tools and Policy The Sacred Relationship: Aboriginal Perspectives on Water.

Conservation, Efficiency and Productivity of Water Use

- Improve water use efficiency
- Take an integrated and 'systems' approach to water challenges
- Develop improved valuation, full cost accounting, and creative use of economic instruments to further drive water conservation and wise choices in water use.

Initiatives include:

- Water: Making Do With What We Have
- Economic Assessment of Ecosystem Services
- Financial Market Based Instruments for Sustainable Water Management
- Virtual Water in Alberta's Irrigated Landscape.

Key Messages

In many instances, presently and in the future, the level of expertise and knowledge already at play in Alberta is world leading. Whenever possible, the initiatives undertaken will be showcased to international audiences as a means of sharing Alberta's expertise and accomplishments around the globe. In addition, where global knowledge and expertise can assist Alberta in meeting its 2020 and 2030 outcomes, it will be actively sought and embedded into the initiatives that are undertaken.

Appendix E
Business Functions

Business Functions

The research and innovation function is the heart of the operations at AI-EES; it is supported by a well rounded team of other professionals.

a. Communications

AI-EES has a Communications Strategy that has been approved by its Board of Directors. This Strategy supports the vision, mission and strategic approach of the organization and is the springboard to telling the AI-EES story in a way that resonates with each of our unique audiences. Our primary communications goal is to position AI-EES as an international leader in advancing technology that supports our business goals.

As the technology transfer and knowledge management component of the operations matures, there will be a greater need for enhanced communications efforts. A strong component of the communications plan is our Technology Talks program. This annual event highlights the projects that are making the greatest impacts in Alberta in a given year. It is an invitation only event that encourages dialogue between the partners in the innovation system.

The creation of Business Plans and Annual Reports are key communications functions as these show Albertans the directions we are taking and what we have achieved. Throughout the year, communications will provide highlights on projects that are making a difference in Alberta. AI-EES communications are about actual achievements and advances in fulfilling our mandate.

b. Accounting and Finance

AI-EES continues to use services provided by Advanced Education and Technology for accounting and finance. This service is provided to AI-EES free of charge, and is a tremendous asset to the corporation. AI-EES is a agency of the Alberta government, and the accounting staff have years of experience in dealing with the public sector accounting standards and practices and ensure that AI-EES meets these standards.

c. Legal Services

Legal services for AI-EES are outsourced. A point person within AI-EES works with external legal representatives to achieve consistency amongst legal agreements and ensure that AI-EES principles are met. AI-EES has recently added an expert in intellectual property and licensing management to its staff complement (the Technology Transfer Manager mentioned above), and this is allowing AI-EES to manage more of its legal contracts internally.

d. Human Resources

A Human Resources consultant works with AI-EES and has provided invaluable support and knowledge in creating policies and practices that provide all staff with a good work environment. Payroll services are outsourced and shared with Alberta Innovates – Bio Solutions.

e. Information Technology

AI-EES receives information technology services from Advanced Education and Technology. They provide the services to evaluate new technology, ensure that privacy and security in systems is maintained, and provides support for new equipment. In addition, they work with the information technology services staff at other Alberta Innovates corporations to look for ways to reduce duplication and coordinate development of new systems. Email services are provided by Alberta Innovates – Technology Futures.

f. Knowledge Management and Technology Transfer

The AI-EES operations model concludes with perhaps the most important step – ensuring that the knowledge gained through investments is transferred to the appropriate entities that can use the knowledge to advance Alberta. By taking this step, new ideas for new projects can often be discovered.

AI-EES has recently engaged a Technology Transfer manager that has the experience and capability to develop a strong program in knowledge management and technology transfer for AI-EES. This is closely tied to the communications function.

The knowledge management focus for the next fiscal year within AI-EES is on building the infrastructure and knowledge management team to deliver timely and coherent information that supports the corporation's business strategies. Provision of the information "back bone" will require implementation of a records and information management system, improvements to the external research reports database and a new project management system that will work in harmony to improve information flow and business processes.

AI-EES will then be better able to deliver on policies of open innovation within collaborative projects and provide the transparency the Alberta Government is looking for where they are active in the energy and environment sectors. We will be able to respond easily to inquiries regarding project deliverables with shared learning's of the impact our funding had on technology innovation. Knowledge capture and follow up on project outcomes will be a key to this success. Linking the project knowledge to informed decision making makes for sound, evidence-based policy decisions and priority strategic investment in the future.

AI-EES supports the open innovation thrusts of the Alberta Innovates system. In general, the policy is to keep all reports confidential for a two-year period following the completion of a project. This gives the industry co-funder an opportunity to assess the technology potential for their operations before public release. In cases where a technology developer is seeking legal protection for an invention he must seek approval from AI-EES and demonstrate that the technology will be licensed at fair market value. Typically after two years, AI-EES publishes the reports on the project; AI-EES is investing taxpayer dollars and, therefore, ensures that the results are widely known and available so that others can build on them or adapt them for their needs.

Alberta
Innovates
Energy and
Environment Solutions